Claims:

1.

An apparatus for compression molding a plastic article, comprising:

a base;

a first actuator carried by the base and including a core,

a second actuator carried by the base and including a female mold section defining a portion of a mold cavity in which the plastic article is formed, said core being at least partially received in said female mold section,

at least one linear bearing associated with at least one of the first actuator and second actuator to guide said at least one of the first actuator and second actuator for linear reciprocation relative to the base, each linear bearing including a rail carried by one of the base and said at least one of the first actuator and second actuator and a block slidably received on the rail and carried by the other of the base and said at least one of the first actuator and second actuator that does not carry said rail.

2.

The apparatus of claim 1 which also includes a plurality of balls carried by the block and wherein the rail includes a track in which the balls are partially received.

3.

1 The apparatus of claim 2 wherein the balls are carried by the block so
2 that at least some of the balls are always in contact with the rail.

4.

1 The apparatus of claim 2 wherein the rail includes two opposed sides
2 each having a track, and said balls are carried by the block so that a plurality
3 of balls engage each of said two opposed sides of the track.

5.

1 The apparatus of claim 4 wherein the balls are carried by the block so
2 that each of said two opposed sides of the rail are always in contact with a
3 plurality of balls.

6.

1 The apparatus of claim 1 wherein both the first actuator and second
2 actuator move relative to the base, and at least one linear bearing is disposed
3 between the base and each of the first actuator and second actuator.

7.

The apparatus of claim 6 wherein at least one linear bearing is disposed between the base and the first actuator, and at least one linear bearing is disposed between the base and the second actuator.

8.

The apparatus of claim 1 wherein two rails are attached to the base in the area of the first actuator, and at least two blocks are carried by the first actuator for linear reciprocation along the rails with at least one block associated with each rail.

9.

The apparatus of claim 8 wherein two blocks are carried by the first actuator for linear reciprocation along one of the rails and one block is carried by the first actuator for linear reciprocation along the other rail.

10.

The apparatus of 9 wherein the base includes a turret driven for rotation about an axis and said first and second actuators are carried by the turret for rotation therewith with said rails being mounted on the turret so that the rails are circumferentially spaced apart and extend generally parallel to the axis of rotation of the turret with one rail leading the other with respect to the direction of rotation of the turret, said two blocks being associated with the leading rail, and said one block being associated with the other rail.

11.

The apparatus of claim 10 wherein the leading rail is axially longer than the other rail.

12.

The apparatus of claim 1 wherein two rails are attached to the base in the area of the second actuator, and at least two blocks are carried by the second actuator for linear reciprocation along the rails with at least one block associated with each rail.

13.

The apparatus of claim 12 wherein two blocks are carried by the second actuator for linear reciprocation along one of the rails and one block is carried by the second actuator for linear reciprocation along the other rail.

14.

The apparatus of 13 wherein the base includes a turret driven for rotation about an axis and said first and second actuators are carried by the turret for rotation therewith with said rails being mounted on the turret so that the rails are circumferentially spaced apart and extend generally parallel to the axis of rotation of the turret with one rail leading the other with respect to the direction of rotation of the turret, said two blocks being associated with the leading rail and said other block being associated with the other rail.

15.

The apparatus of claim 14 wherein the leading rail is axially longer than the other rail.

16.

An apparatus for compression molding a plastic article, comprising:

a base;

a first actuator carried by the base and including a male mold section and a first female mold section formed in at least two sections disposed adjacent to at least a portion of the male mold section;

a second actuator carried by the base and including a second female mold section, said male mold section being at least partially received in said second female mold section so that said first female mold section, said male mold section and said second female mold section define a mold cavity in which said plastic article is formed;

a first cam assembly associated with said first female mold section to drive said at least two sections toward each other to a closed position and away from each other to an open position; and

a second cam assembly associated with said first female mold section to reciprocate said at least two sections in a second direction different from said first direction, said second cam assembly being capable of operating independently of the first cam assembly.

17.

The apparatus of claim 16 which also includes a third cam assembly associated with the first actuator to drive the first actuator toward and away from the second actuator, and wherein the first cam assembly and second cam assembly are capable of operating independently of the third cam assembly.

18.

The apparatus of claim 16 which also includes a fourth cam assembly associated with the second actuator to drive the second actuator toward and away from the first actuator, and wherein the first cam assembly and second cam assembly are independent of the fourth cam assembly.

19.

The apparatus of claim 16 wherein the first female mold section includes two thread split halves that surround a portion of the male mold section and define an annular chamber between the thread split halves and the male mold section when the thread splits are in their closed position, and said thread splits are radially spaced apart from each other when driven toward their open position by said first cam assembly.

20.

The apparatus of claim 16 wherein said male mold assembly has an axis and said second cam assembly drives said first female mold assembly in a direction parallel to the axis of the male mold assembly and relative to the male mold assembly.

21.

The apparatus of claim 16 wherein said first cam assembly includes a first follower carried by the first actuator and operably connected to the first female mold section, said first follower being responsive to a cam surface to drive said at least two sections toward and away from each other.

22.

The apparatus of claim 16 wherein said second cam assembly includes a second follower carried by the first actuator and operably connected to the first female mold section, said second follower being responsive to a cam surface to reciprocate said at least two sections relative to the male mold section in said second direction.

23.

The apparatus of claim 21 wherein said first actuator includes a main body and said male mold section is carried by said main body, and said first follower is carried by said first actuator for movement relative to the main body.

24.

The apparatus of claim 21 wherein said first cam assembly includes a cam plate operably connected to said first follower and a pair of followers each operably connected to a different one of said at least two sections and responsive to movement of the cam plate, movement of said first follower in response to changes in the contour of said cam surface causing said cam plate to move relative to said followers operably connected to said two sections to cause said at least two sections to move between said open and closed positions.

25.

The apparatus of claim 24 which also includes a carrier plate that slidably carries said at least two sections for movement in said first direction, said second cam assembly being operably connected with said carrier plate to drive said carrier plate and said at least two sections in said second direction.

26.

The apparatus of clam 25 wherein said first follower is connected to said cam plate by a rod, and said second follower is connected to said carrier plate by a tubular sleeve that slidably receives the rod.

27.

The apparatus of claim 16 wherein said at least two sections can be driven by said first cam assembly independently of said second cam assembly.

28.

An apparatus for compression molding a plastic article, including:

a base,

an actuator carried by the base and having a main body, a mold section assembly including a mold section that defines part of a mold cavity in which a plastic article is formed, said mold section assembly being carried by the main body, and a cam follower carried by the main body for selective engagement with a cam surface to move the first actuator relative to the base; and

a releasable coupler mounting the mold section assembly to the main body so that the mold section assembly is connected to and moves with the main body, said releasable coupler being constructed and arranged to release

when acted upon by a force through said mold section assembly that is sufficiently greater than the normal operating forces applied to the releasable coupler through the mold section assembly in normal operation of the apparatus so that the mold section assembly is no longer connected to the main body.

29.

The apparatus of claim 28 wherein said releasable coupler includes a shear plate adapted to break when acted upon by a force through said mold section assembly that is sufficiently greater than the normal operating forces applied to the shear plate.

30.

The apparatus of claim 29 wherein said plate is constructed and arranged to break before said cam follower is damaged by said force acting on said main body through said mold section assembly.

31.

The apparatus of claim 29 wherein a plurality of mold section assemblies are carried by the first actuator and a separate plate is provided for each mold section assembly so that each mold section assembly and each plate is independently connected to the main body.

32.

A mold tooling assembly for an apparatus for compression molding a plastic article, said mold tooling assembly including:

a main body,

a mold section slidably carried by the main body and defining part of a mold cavity in which a plastic article is formed,

a biasing member yieldably biasing the mold section and capable of preventing movement of the mold section against the biasing force when said mold section is acted upon by forces of a magnitude associated with molding a plastic article, but permitting said mold section to move against said biasing force when acted upon by forces of greater magnitude than those associated with molding a plastic article.

33.

The mold tooling assembly of claim 32 wherein said biasing member includes a fluid cylinder having a plunger acted upon and extended by pressurized fluid in the cylinder and retracted against the force of the pressurized fluid, said plunger being operably associated with said mold section.

34.

The mold tooling assembly of claim 32 which also includes a sleeve carried by the main body surrounding the mold section, said sleeve providing a bearing surface for axial movement between the mold section and the sleeve.

35.

The mold tooling assembly of claim 34 wherein the main body includes a chamber formed therein and said sleeve is slidably received in the chamber for axial reciprocation relative to the mold section.

36.

The mold tooling assembly of claim 35 which also includes at least one spring yieldably biasing the sleeve to an extended position wherein an end of the sleeve extends outwardly from the main body.

37.

The mold tooling assembly of claim 36 wherein said end of the sleeve that extends outwardly from the main body when the sleeve is in its extended position includes a radially tapered alignment surface adapted to engage and align a second mold section with said mold section carried by the main body.

38.

The mold tooling assembly of claim 34 which also includes at least one body disposed between the mold section and the biasing member, said at least one body being connected to the body, at least partially received in the sleeve and guided for reciprocation by the sleeve.

39.

The mold tooling assembly of claim 38 wherein said at least one body includes at least one coolant passage and said mold section includes at least one coolant passage in communication with said at least one coolant passage in said body so that coolant can be provided to the mold section through said body.

40.

The mold tooling assembly of claim 35 wherein said sleeve aligns said mold section relative to the main body, with both the sleeve and mold section being movable relative to the main body.

41.

A mold core assembly for a compression molding apparatus, said mold core assembly including:

a tubular outer sleeve;

a mold core defining at least part of a coolant chamber carried by the outer sleeve with at least a portion of the mold core extending from the outer sleeve;

an inner sleeve received within the outer sleeve and having an outer diameter that is smaller than the inner diameter of the outer sleeve providing an air gap between the outer sleeve and inner sleeve;

an inner tube having a central passage permitting fluid flow therethrough, the inner tube being disposed within the inner sleeve and having an outer diameter that is smaller than the inner diameter of the inner sleeve to define at least part of a fluid passage between the inner tube and the inner sleeve,

a coolant supply passage for communicating at one end with a coolant supply and at its other end with said coolant chamber, the coolant supply passage including said central passage of the inner tube; and

a coolant return passage communicating the coolant chamber with a coolant outlet through said fluid passage enabling a flow of coolant from the coolant chamber out of the mold core assembly.

42.

The mold core assembly of claim 41 which also includes a collar portion of the mold core and has a hole through which the inner tube extends, said hole having an inner diameter that is greater than the outer diameter of the tube defining part of the coolant return passage between the collar portion and inner tube.

43.

The mold core assembly of clam 41 wherein seals are provided at both ends of the inner sleeve to prevent coolant from entering the air gap between the inner sleeve and outer sleeve.

44.

The mold core assembly of claim 43 which also includes a cap fixed to the outer sleeve and wherein a seal is provided between said cap and said inner sleeve.

45.

The mold core assembly of claim 44 wherein said cap includes an annular groove in which one end of the inner sleeve is sealingly received.

46.

The mold core assembly of claim 42 wherein said collar portion is threadedly connected to the outer sleeve.

47.

The mold core assembly of claim 41 which also includes a shear plate disposed between a portion of the mold core assembly and a body that carries the mold core assembly, the shear plate being responsive to the forces applied to the mold core and constructed to break and release the mold core assembly from said body when a force greater than a maximum force is applied to the mold core.

48.

An apparatus for compression molding a plastic article, including:

a first actuator having a first main body, a first mold section carried by the first main body and a locking rod carried by the first main body;

a second actuator having a second main body, a second mold section carried by the second main body, a bore in the second main body adapted to receive the locking rod, a transverse bore in the second main body that communicates with said bore, and a slide bar disposed at least partially within the transverse bore and having a slot adapted to receive and selectively trap a portion of said locking rod, at least one of said first actuator and second actuator being moveable relative to the other between an open position where

the first and second actuators are spaced apart and a closed position wherein the first and second actuators are together to define a mold cavity between the first mold section and second mold section, the locking rod being received within the bore when the actuators are in their closed position and said slide bar being movable relative to the locking rod so that said slot receives a portion of said locking rod and a portion of the locking rod is releasably trapped by said slide bar to maintain the actuators in their closed position.

49.

The apparatus of claim 48 wherein said locking rod includes an enlarged end and said slot includes an entrance portion sized to receive said enlarged end of the locking rod therethrough and a retaining portion smaller than said entrance portion and said enlarged end of the locking rod, said entrance portion being initially aligned with said bore to permit said enlarged end of said locking rod to be received through said slot when said actuators are in their closed position and thereafter, said slide bar being moved within the transverse bore to move said retaining portion of said slot over said enlarged end of the locking rod to prevent withdrawal of the enlarged end of the locking rod from said slot.

50.

The apparatus of claim 49 wherein said locking rod has a key portion that includes said enlarged end and a reduced diameter portion adjacent to said key, the retaining portion of said slot being sized to received the reduced diameter portion of the locking rod.

51.

The apparatus of claim 48 which also includes a cam assembly associated with the slide bar to move the slide bar within the transverse bore relative to the bore.

52.

The apparatus of claim 51 wherein the cam assembly includes a follower carried by the slide bar and responsive to one or more cam surfaces to move the slide bar within the transverse bore.

53.

The apparatus of claim 49 wherein the slide bar is moved between retracted and extended positions in the transverse bore, with said entrance portion aligned with the bore when the slide bar is in its retracted position and said retaining portion aligned with the bore when said slide bar is in its extended position.

54.

The apparatus of claim 48 wherein said locking rod extends axially from a center of the first actuator, and said bore extends axially along a center of the second actuator so that when the first and second actuators are locked together, the forces tending to separate the first and second actuators act on the locking rod along its axis.

55.

The apparatus of claim 54 wherein the first actuator carries a plurality of first mold sections and said locking rod is centered between said plurality of first mold sections.

56.

The apparatus of claim 54 wherein the second actuator carries a plurality of second mold sections and said bore is centered between said plurality of second mold sections.

57.

The apparatus of clam 49 wherein said slide bar includes a recess in the area of the entrance portion of the slot, said recess adapted to receive the enlarged end of the locking rod.

58.

The apparatus of claim 48 wherein at least one of said first main body and said second main body includes a flange on which said first and second actuators can be carried when in their closed position.

59.

An apparatus for compression molding a plastic article, including:

a base rotatable about an axis;

a plurality of mold tooling pairs carried by the base for rotation with the base, with each pair having a first actuator that carries at least two radially spaced first mold sections and a second actuator that carries at least two radially spaced second mold sections, the first actuator being movable relative to the second actuator to move the first mold sections relative to the second mold sections;

a first cam follower carried by the first actuator and associated with one first mold section;

a second cam follower carried by the first actuator and associated with the other first mold section with the second cam follower being radially spaced from said first cam follower;

at least one cam plate disposed about a portion of the periphery of the rotatable base and providing a radially inner cam path including cam surfaces to drive the first cam follower and cause a corresponding movement of the first mold section associated with the first cam follower and a radially outer

cam path including cam surfaces to drive the second cam follower and cause a corresponding movement of the first mold section associated with the second cam follower, the first and second cam followers being engaged with their associated cam path as the turret rotates said first actuator by said cam plate.

60.

The apparatus of claim 59 wherein said at least one cam plate includes at least one inner cam plate defining at least a portion of said radially inner cam path and at least one outer cam plate defining at least a portion of said radially outer cam path.

61.

The apparatus of claim 59 wherein the inner cam path and outer cam path are parallel so that the first mold section associated with the first cam follower and the first mold section associated with the second cam follower have the same path of movement.

62.

The apparatus of claim 59 which also includes a third cam follower carried by the first actuator and associated with said one first mold section and a third cam path defined at least in part by said cam plate, said first cam follower responsive to the contour of its associated cam path to drive said one

first mold section in a first direction and said third cam follower responsive to the contour of the third cam path to drive at least a portion of said one first mold section in a second direction different from said first direction.

63.

The apparatus of claim 62 wherein said one first mold section includes at least two thread splits movable relative to each other between open and closed positions, and said thread splits being moved toward and away from the second actuator when moved in said first direction and said thread splits being moved relative to each other between their open and closed positions when moved in said second direction.

64.

The apparatus of claim 59 wherein said inner cam path is formed at least in part by a cam module releasably carried by said cam plate.

65.

The apparatus of claim 64 wherein said cam module is adjustably carried on the cam plate so that the position of the cam module on the cam plate can be changed.

66.

The apparatus of claim 59 wherein said outer cam path is formed by at least two cam plates releasably carried by said cam plate.

67.

The apparatus of claim 66 wherein said cam module is adjustably carried on the cam plate so that the position of the cam module on the cam plate can be changed.

68.

The apparatus of claim 62 wherein said first cam path and said third cam path are defined at least in part by a cam module releasably carried by the cam plate.

69.

A method of compression molding a plastic article, including the steps of:

providing a base rotatable about an axis;

mounting a first actuator on the base by a linear bearing including a rail carried by one of the first actuator and the base and a block carried by the other of the first actuator and the base that does not carry the rail, the first actuator carrying a first mold section that defines in part a mold cavity;

mounting a second actuator on the base, the second actuator carrying a

second mold section that defines in part a mold cavity;

providing at least one cam plate adjacent to the base and selectively engageable with the first actuator during a portion of the rotation of the base;

rotating the base relative to said cam plate to selectively engage said first actuator to move the first actuator along said rail relative to the second actuator, the first actuator and second actuator being closed together during a portion of the rotation of the turret to form a plastic article between the first and second mold sections, and the first actuator and second actuator being separable to remove a formed plastic article from the mold sections and to receive a fresh charge of plastic.

70.

The method of claim 69 wherein said step of mounting the second actuator on the base includes mounting the second actuator on the base by a linear bearing including a rail carried by one of the second actuator and the base and a block carried by the other of the second actuator and the base that does not carry the rail.

71.

The method of claim 70 which also includes the step of providing a second cam plate operably associated with the second actuator during a portion of the rotation of the base to move the second actuator relative to the first actuator.

72.

The method of claim 69 which also includes the step of locking together the first and second actuators when they are closed together to maintain them closed even after they are rotated past the cam plate by the base.

73.

A mold tooling assembly for an apparatus for compression molding a plastic article, said mold tooling assembly including:

a main body having a chamber formed therein;

a tubular sleeve carried by the main body and slidably disposed in said chamber; and

a mold section defining at least part of a mold cavity in which a plastic article is formed, said mold section being slidably received in said sleeve for movement relative to the main body and the sleeve, said sleeve maintaining the alignment of said mold section with said sleeve and said main body.

74.

The mold tooling assembly of claim 73 wherein said mold section is closely received in said sleeve and said sleeve provides a bearing surface for the movement of the mold section.

75.

The mold tooling assembly of claim 73 which also includes at least one tooling body coaxially aligned with said mold section, slidably disposed in said sleeve and responsive to movement of the mold section so that said tooling body moves with said mold section relative to the sleeve.

76.

The mold tooling assembly of claim 75 wherein said sleeve maintains said tooling body coaxially aligned with said mold section.

77

The mold tooling assembly of claim 75 wherein said tooling body includes at least one passage communicating with the mold section to enable fluid flow to the mold section.

78.

The mold tooling assembly of claim 73 wherein said sleeve includes a tapered surface adjacent one end of the sleeve adapted to align an adjacent mold section with said mold section carried by said main body.

79.

The mold tooling assembly of claim 78 which also includes a spring that yieldably biases the sleeve to an extended position wherein an end of said sleeve and at least a portion of said tapered surface extends outwardly from the main body.

80.

The mold tooling assembly of claim 73 wherein said sleeve is yieldably biased by a spring to an extended position wherein an end of the sleeve extends from the main body.

81.

A method of compression molding a plastic article, including the steps of:

providing a first actuator carried by a base and including a male mold section and a first female mold section formed in at least two sections disposed adjacent to at least a portion of the male mold section;

providing a second actuator carried by the base and including a second female mold section;

removably disposing said male mold section at least partially in said second female mold section so that said first female mold section, said male mold section and said second female mold section define a mold cavity in which said plastic article is formed;

selectively actuating a first cam assembly associated with said first female mold section to drive said at least two sections toward each other to a closed position and away from each other to an open position; and

selectively actuating a second cam assembly associated with said first female mold section to reciprocate said at least two sections in a second direction different from said first direction, said second cam assembly being capable of operating independently of the first cam assembly.

82.

The method of claim 81 wherein said step of actuating said first cam assembly includes moving said at least two sections to their closed position prior to said disposing step to facilitate forming a plastic article, and then moving said at least two sections toward their open position after a plastic article is formed and after said male mold section has been removed from said second female mold section to facilitate stripping a formed plastic article from the male mold section.

83.

The method of claim 82 wherein said step of actuating the second cam assembly includes advancing said at least two sections relative to the male mold assembly after said at least two sections are moved toward their open position to facilitate stripping a formed plastic article from the male mold section.

84.

The method of claim 81 which also includes the steps of stripping a formed article from the male mold section by at least partially removing the male mold section from the second female mold section, moving said at least two sections toward their open position while maintaining contact between said at least two sections and said formed plastic article, moving said at least two sections relative to the male mold section to move the formed plastic article relative to the male mold section, and further moving said at least two sections toward their open position to remove said at least two sections from said formed plastic.

85.

A method of compression molding a plastic article, including the steps of:

providing a first actuator having a locking rod and defining in part a mold cavity in which a plastic article is formed;

providing a second actuator having a bore adapted to receive the locking rod, a second bore that communicates with said bore, and a slide bar disposed at least partially within the second bore and having a slot adapted to receive and selectively trap a portion of said locking rod,

moving at least one of the first actuator and the second actuator so that the actuators are in a closed position wherein the first and second actuators

are together to define a mold cavity and the locking rod is received within the bore, and

moving said slide bar relative to the locking rod so that said slot receives a portion of said locking rod and a portion of the locking rod is releasably trapped by said slide bar to maintain the actuators in their closed position.

86.

The method of claim 85 wherein said step of moving said slide bar includes moving said slide bar in a direction perpendicular to the movement of said at least one of the first and second actuators to the closed position of the first and second actuators.

87.

The method of claim 85 wherein said step of moving said slide bar is accomplished by providing a cam assembly operably associated with the slide bar to move the slide bar relative to said second actuator, and actuating said cam assembly to move the slide bar.

88.

The method of claim 87 wherein said cam assembly includes a cam follower carried by the slide bar and a cam surface generally aligned with the cam follower and said step of moving said slide bar is accomplished by moving said cam follower relative to said cam surface.

89.

The method of claim 88 wherein said step of moving said slide bar is accomplished by moving said first actuator and said second actuator relative to the cam surface to engage the cam follower on the slide bar with the cam surface.

90.

An apparatus for compression molding a plastic article, comprising:

a base;

a first actuator including a core;

a second actuator including a female mold section defining a portion of a mold cavity in which the plastic article is formed, said core being at least partially receivable in said female mold section, at least one of the first actuator and second actuator being movable relative to the other of the first actuator and second actuator to and away from a closed position of the actuators in which they define a mold cavity for forming a plastic article;

a bracket carried by the base; and

a support carried by one of the first actuator and the second actuator and adapted to be selectively engaged with the bracket to selectively carry the first actuator and second actuator on the bracket.

91.

The apparatus of claim 90 which also includes a lock assembly carried by at least one of the first and second actuators to releasably lock the first and second actuators in their closed position, with the first and second actuators being carried on the bracket when they are locked in their closed position.

92.

The apparatus of claim 90 wherein the actuator that includes said support is disposed above the other actuator.

93.

The apparatus of claim 92 wherein said first actuator is disposed above said second actuator, and said support is carried by said first actuator.